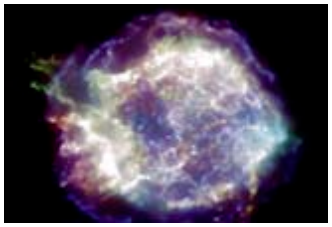

Powerful Space Bursts Reflect Two Ways to Make Black Holes

By Robert Roy Britt
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Astronomers have been logging powerful bursts of energy coming from deep space ever since the first so-called gamma-ray burst was discovered, by accident, in 1967. Those initial GRBs, as scientists call them, were noted by U.S. satellites deployed to monitor possible violations of the nuclear test ban treaty.

Back then, researchers thought the brief, high-energy blasts originated relatively nearby, perhaps in our own Milky Way Galaxy. It's now known the GRBs come from every direction of space and originate mostly in other galaxies.

Gamma rays represent the high end of the electromagnetic spectrum, which also includes X-rays, just a notch down, and continues into lower forms of energy like visible light and radio waves.

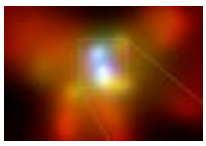
Nearly a year ago, two separate studies firmly linked GRBs to exploding stars called supernovae. But one thing has continued to puzzle astronomers: The bursts seem to come in two distinct varieties, those lasting less than two seconds and those lasting longer.

A new study of 1,972 bursts on file (collected by NASA's Compton Gamma Ray Observatory, which was de-orbited in 2000) supports the growing consensus that the short bursts come from dramatic mergers of black holes or other massive objects, like neutron stars. Computer modeling of these mergers suggests tremendous radiation would be unleashed as matter is squashed between the colliding objects. Mergers occur on a far greater scale when two galaxies meet up, their central, supermassive black holes eventually falling together.

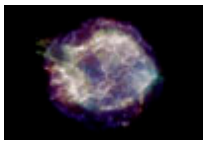
The longer bursts, according to the new study, appear to originate from the biggest supernovae, explosions of stars that are more than 30 times the mass of our Sun. Such explosions leave some material behind, which collapses back into what's known as a stellar black hole, theory holds. These dense objects pack the mass of several suns into a region no bigger than a city.

"It is suspected that, either way, with each gamma-ray burst we wind up with a brand new black hole," said Penn State's Peter Meszaros. "The puzzle is in trying to identify clues

Images



The Chandra image of NGC 6240, a butterfly-shaped galaxy that is the product of the collision of two smaller galaxies, revealed that the central region of the galaxy (inset) contains not one, but two active giant black holes.



Chandra X-ray Observatory image of supernova remnant Cassiopeia A. At the center is what astronomers believe to be a rapidly spinning neutron star or black hole. CREDIT: NASA/CXC/SAO

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that would help to elucidate whether these two types consist of essentially the same objects with different behaviors, or different objects with somewhat similar behavior."

Lajos Balazs of the Konkoly Observatory in Budapest led the study, which will be detailed in the journal *Astronomy & Astrophysics*.

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"We can now say with a high degree of statistical certainty that the two show a different physical behavior," Balazs said.

The first serious evidence that gamma-ray bursts might be created as a byproduct of black hole formation, in the aftermath of a supernova, came in 2001. Researchers then suggested that a strong electrical field would develop, then be converted into matter and anti-matter in a fraction of a second. Opposing electrons would collide, generating a pulse of energy that would expand at light speed and run into stuff leftover from the star's previous explosion and collapse. The expanding pulse would heat the material to billions of degrees, generating gamma rays.

In the effort to learn more about all this, supernova hunting has gained steam in recent years and is expected to ratchet up in both quantity and quality of discoveries as researchers employ a recently installed, more powerful camera on the Hubble Space Telescope.

Other telescopes are also involved in the search, and the findings are varied. One recent study shows that the central region of the Milky Way is poised for an explosion of stellar explosions within the next 200 million years or so. Of more immediate consequence is the relatively nearby star, Rho Cassiopeiae, which could explode at any time and is likely to be noticeable to backyard stargazers, astronomers said earlier this year.

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